

SECRET

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PAR 216

30 Nov 64

SUBJECT: Exposure of Photographic Material with Lasers

TASK/PROBLEM

1. Determine the manner and degree of the interaction of present and predictable future photographic films with coherent radiation from laser sources in red and near IR spectrum ranges.

DISCUSSION

2. During this quarter a study was made of the effects of laser illumination in a high-quality photographic projection system. The targets used in this evaluation consisted of several reticle patterns. To display these targets, each was projected on a 4 x 5 inch sheet of panchromatic film using both laser and tungsten filament illumination. The resulting exposures were subsequently printed, compared and evaluated.

3. This effort represented an extension of the reticle projection study completed and reported in the first quarterly report dated 8 September 1964. In the earlier study, the quality of the projection optics and the instability of the over-all mechanical system precluded a detailed quantitative evaluation of the results. The present system, shown in Figure 1, has removed these limitations. The complete breadboard is set up on a rigid shock-mounted surface plate and located in a photographically dark laboratory. The elements of the system are mounted in aluminum blocks and are located in one of two hardwood vee-troughs which lie parallel to the optical path. A schematic view of the optical system without the two mirrors is shown in Figure 2.

4. Before the experimental work was started with this new projector, we were visited by a representative of the customer. Our proposed effort in studying spatial filtering and performance of photographic films as the object in a laser illuminated projection system was quite similar to work already well advanced under the customer's sponsorship in another laboratory.

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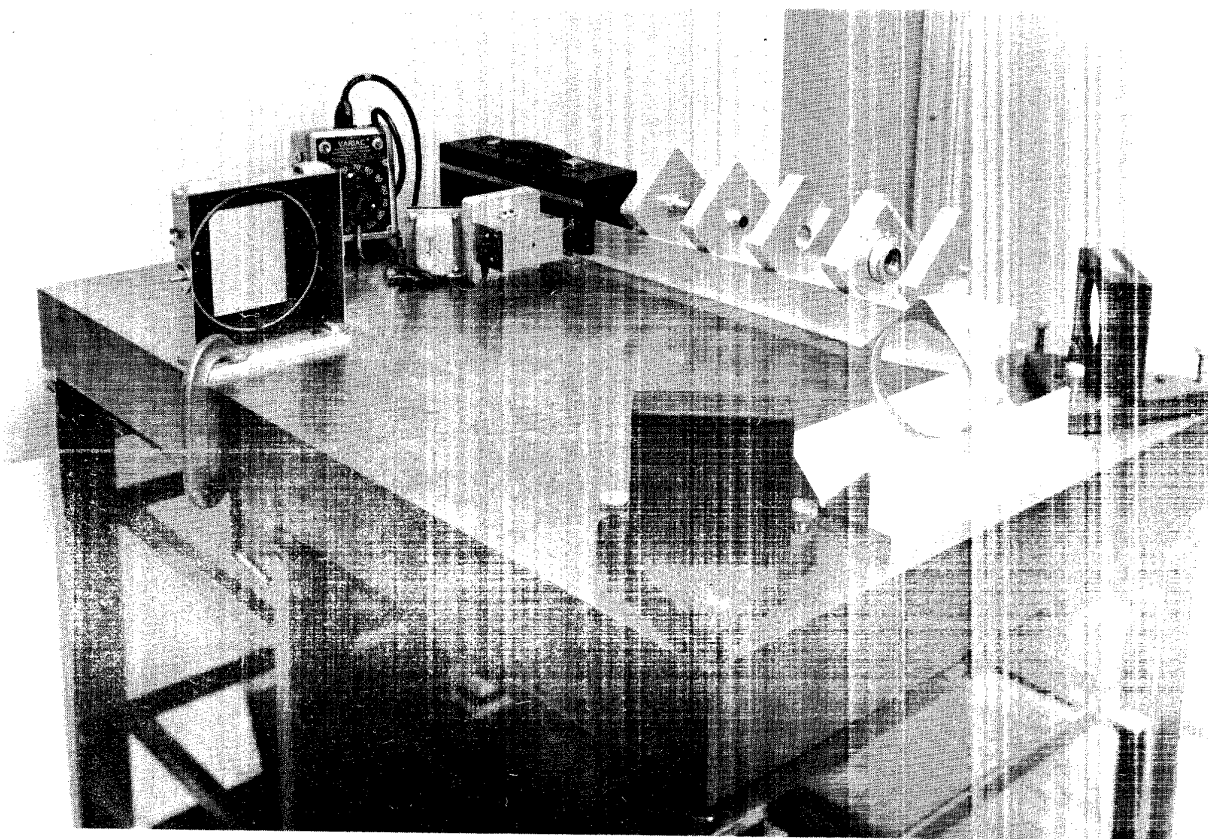


Figure 1. The Surface Plate Mounted Photographic Projection System

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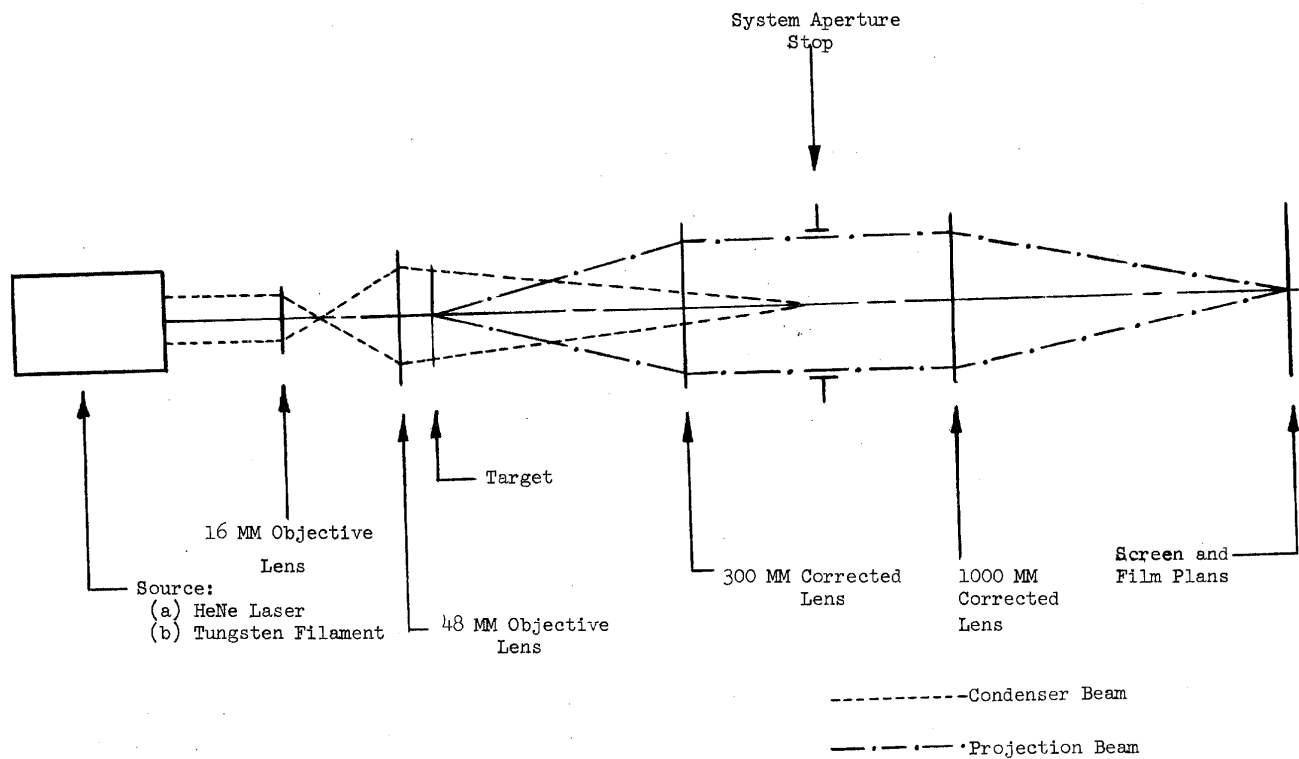
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Projection System Schematic

Fig. 2

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We were instructed to complete our effort to duplicate the examples shown in Quarterly Report No. 1 for FY-65 with the diffraction limited projector and to terminate the laboratory work.

5. The experiment that was completed involved projecting a [] magnifier reticle with the reticle located at the optimum focal position and several positions beyond focus. Figure 3 shows the results of these projections with the tungsten filament source as the illuminator. Figure 3a shows the projected image with the reticle in focus. Figures 3b, 3c, 3d show successive images of the reticle as it is moved nearer the film plane in quarter-inch increments. It is apparent that recognition is almost completely lost for a reticle shift in excess of one-quarter inch. The degradation, however, is very similar to that obtained with the initial projection system.

6. Figure 4 shows an identical sequence of exposures using the [] HeNe gas laser as the illuminator. Again, as with the initial system, a constructive reinforcement of the reticle lines is quite pronounced. The circular interference patterns, however, are much more severe. The consequence of these strong overlapping fringe patterns is that the resolution characteristics of the exposures cannot be adequately measured. As a result, no conclusion can be drawn regarding any improvement of the new projection system. The interference patterns are more severe because of an increase in the number of glass-air surfaces in the optical system. The initial system had 4, the current system has 12.

7. It should also be noted that the initial system had a magnification of about 28 times and the prints were contact prints. Our present system has a 3X magnification, and the prints are approximately 8X enlargements.

PLANNED ACTIVITY

8. The final report on this project is in preparation and is scheduled for completion within the first period of the next quarter.

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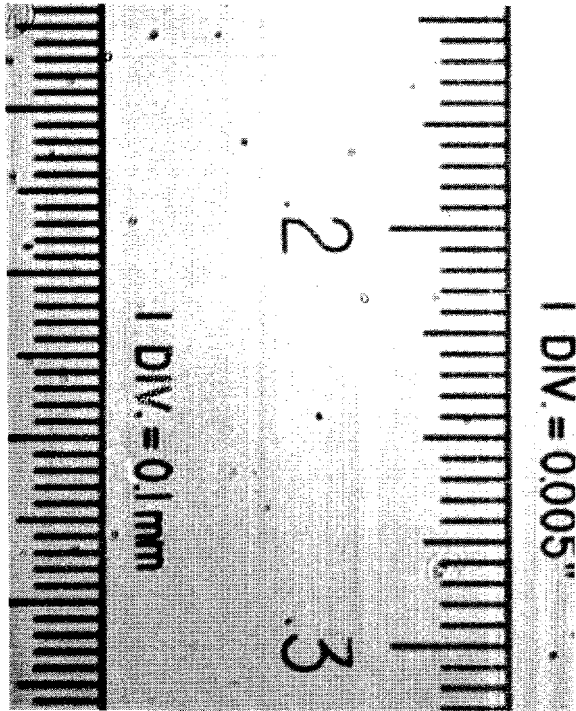


Figure 3a

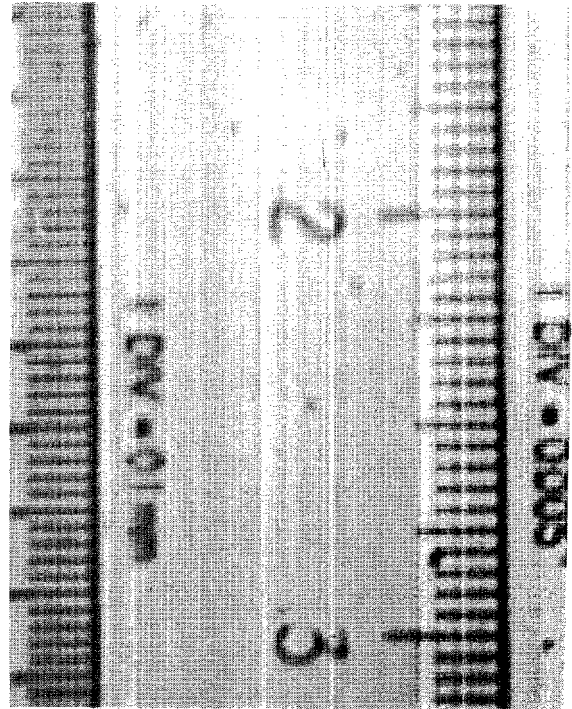


Figure 3b

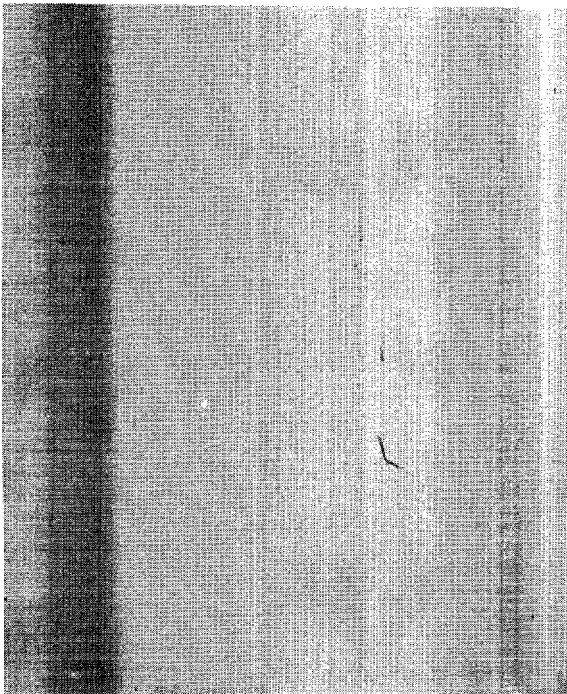


Figure 3c

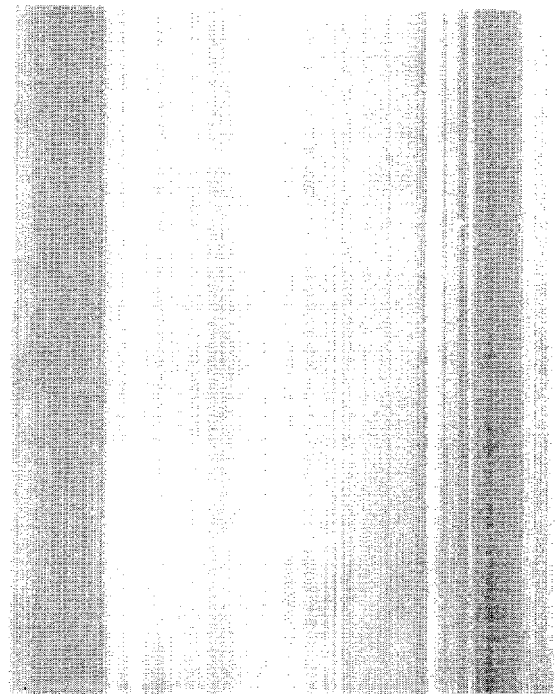


Figure 3d

Figure 3. Projected Image of Reticle Pattern with Increasing Amounts of De-Focusing (Tungsten Source)

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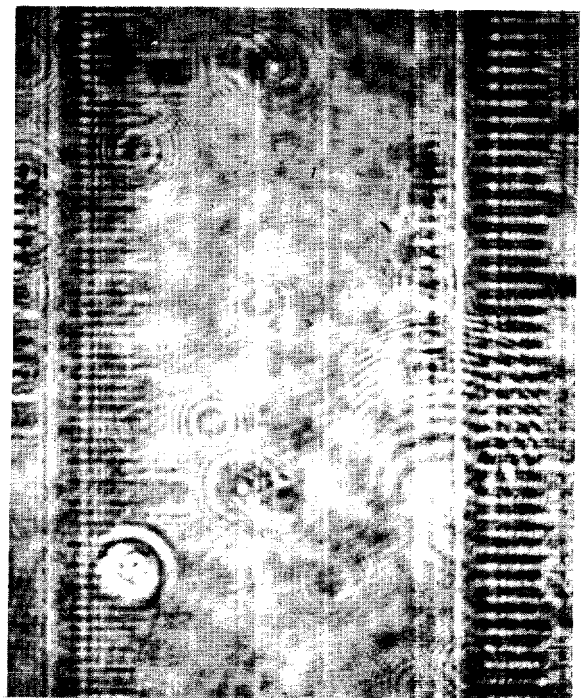
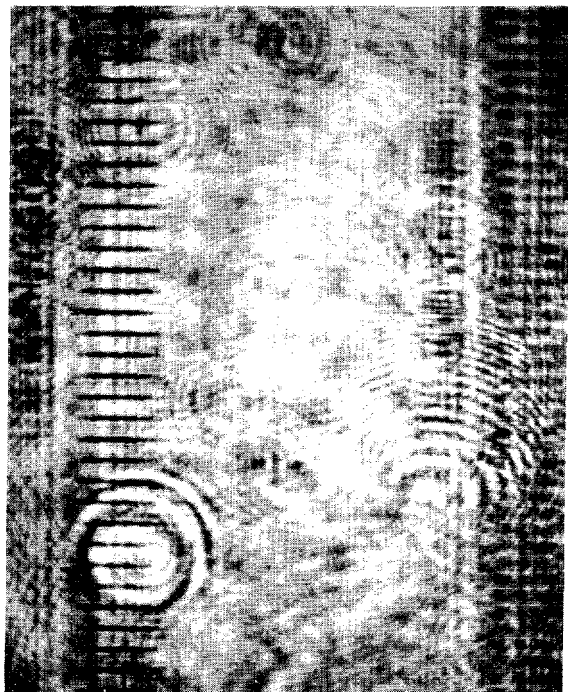
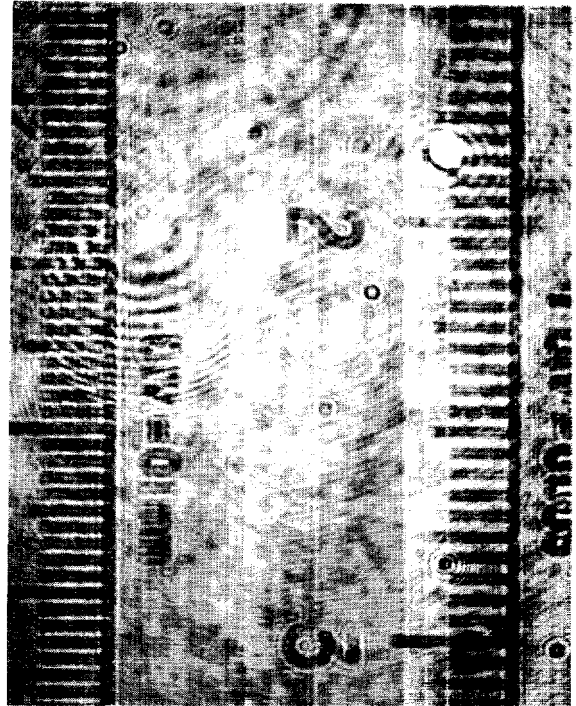
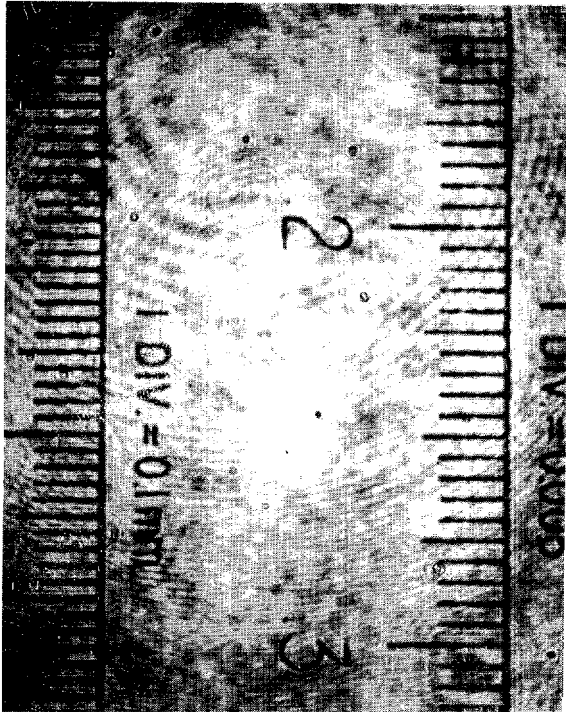


Figure 4c

Figure 4d

Figure 4. Projected Image of Reticle Pattern with Increasing Amounts of De-Focusing (HeNe Laser Source)

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